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FINAL TECHNICAL REPORT

for NASA GRANT #NAG 5-509 titled

HIGH RESOLUTION SPECTROSCOPY OF CARBON DIOXIDE LINESHAPES

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Research Summary:

Our past experimental studies have shown that line mixing in N_2-broadened Q-branches exhibit more line mixing than expected if CO_2-N_2 collision behave similarly to CO_2-CO_2 collisions. We have modeled the observed N_2-broadened Q-branch spectra by the introduction of a new parameter that governs the ratio of f-->f collisions to f-->e collisions in the l-doubled vibrational state that participates in these transitions. For self-broadeded spectra, good agreement with experiment is obtained by assuming that this ratio is unity. For the N_2-broadened spectra, good agreement with experiment is only possible by raising this ratio to 1.7, e.g. f-->f collisions are more likely than f-->e collisions. This is consistent with ab-initio calculations done for CO_2-He collisions in that this ratio was found to be larger than one for a wide range of collisional rates at different J with various delta J's. This work was reported at the Molecular Spectrosopy Symposium, June 1990.

. This improved model for N_2-broadened line mixing in CO_2 was tested using atmospheric spectra taken by the ATMOS instrument on Spacelab 3. Line mixing in the 791 cm-1 and 618 cm-1 CO_2 Q branches were examined. We obtained excellent agreement with observation, not only for the Q branches but also for the far-wing line continuum from the strong 667 cm-1 CO_2 Q branch. Our line mixing formulation was ported into the GENLN2 line-by-line code for this work (GENLN2 was written by Dr. David Edwards while at Oxford University and at his present place of employment, National Center for Atmospheric Research). A paper describing this work has been submitted to J. Geophy. Res.